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Communities Pattern of Fuel Wood Exploitation and the Perceived Impact of Afforestation Programme in Northern Katsina State, Nigeria

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Abstract
This study examines the pattern of fuel wood exploitation and the observed impact of afforestation programme around some villages of northern Katsina state. Twelve villages were purposely selected in the six local governments that shared border with Niger republic. Baseline questionnaires with open and close - ended questions were used to get the relevant information. Focus Group Discussion of 8-12 people were held in each of the 12 villages for clarifying and balancing of information gathered through questionnaire. It was found that large proportions of the population depend on fuel wood and crop residue for their energy requirements. The fuel wood is largely got from individual's farms, surrounding forest reserve, and exotic trees plantations and shelter belts. Majority of the respondents indicated that fuel wood is increasingly getting scarce; sometimes villagers have trekked more than 3 kilometers to get fuel wood. All the respondents mentioned positive impact of afforestation programme such as minimizing the effects of wind and water erosion, enhancing soil fertility and increasing crop yield.
Keywords: fuel wood, exploitation, afforestation programme, semi-arid, Northern Katsina state

INTRODUCTION

Semi-arid areas of Nigeria are facing many environmental challenges particularly desertification which is believed to be expanding rapidly at the rate of 0.6 kilometer per annum (Medugu, 20011). Planting and retaining of trees and shrubs has been seen as a viable solution to land degradation problems in these areas. Trees and shrubs act as wind break and their canopy help to minimize the erosive power of rain; fallen leaves forms a protective cover on the soil surface, the of trees help in holding the soil in place, thereby reducing the rate of erosion (Adegbehin, 1990 Apart from ecosystem services, trees serve as shade and shelter, building materials, fodder for livestock and source of different product such as wild food, gum and medicine. Despite the importance of trees to the environment and local economy of the rural population, trees are continuously destroyed and used as fuel wood for domestic and industrial use in developing countries.

Fuel wood play a crucial role in the socio-economic lives of large number of people, it accounts for about 90% of rural household energy consumption (Ayodele et al., 2000) Even in urban areas of developing countries where alternative source of energy exist, fuel wood still remain the main source of domestic energy. Harvesting wood trees for fuel is the only viable option to the rural farming community, as alternative fuel sources are either non-existent or too expensive to afford. The choice of trees for fuel wood is influenced by many factors which include ability to produce high quality charcoal; ability to generate considerable heat with minimum smoke; softness of the wood during cutting and splitting; and ability to dry quickly when cut wet, hence the farmers prefer the following species for used as feulwood *Balanites aegyptica, Ziziphus spinachristi, Acacia raddiana, Acacia seyel* and *Acacia nilotica* (Chiroma,1996).

As population increases, the indispensable nature of wood energy has resulted in increasing demand, supply as well as consumption in most countries. Several factors have been identified as contributing to the increasing demand and consumption of fuel wood. Ayodele et al., (2000) noted that wood production and consumption vary considerably with the availability of wood and alternative fuels, cooking habits, heating requirements and the like. In Nigeria for instance, some researchers traced the genesis of increased fuel wood consumption to the post oil boom era to the introduction of the Structural Adjustment Program (SAP) and subsequent increases in the prices of petroleum products (Hamza, 1995). Ayodele et al., (2000) reported the study of Montalembert and Clement (1983) who studied 100 households in Ikire Nigeria and found out that energy use and choice of fuel are dependent on; price of the relevant energy source, availability of substitutes, fuel preference of the consumer, rural-urban migration, household income and size, cultural factors, cost and performance of end-use equipment.

Generally, the demand and consumption of fuel wood have certain implications, which are both beneficial and adverse in nature. The beneficial aspect is manifested in the expanding fuel wood market\trade and the associated economic gains. According to Morgan (1978) fuel wood trade in Nigeria involves organized cutting by gangs of labourers working for rural dealers who sell to urban dealers in an organized system of production and supply. Dealing in fuel wood does not only provide additional income for farmers during the off farm seasons, it create additional jobs for full time dealers. According to the United Nations University (1996), Fuel wood demand creates markets, provides job opportunity for men and women and save foreign exchange that might have been used in importing fuels. Apart from economic benefits, fuel wood exploitation has adverse effects on the people and their environment Medugu (2011) reported that deforestation due to uncontrolled cutting of wood for firewood and charcoal, for construction and for other domestic and industrial uses, is another major cause of desertification. He cited the "World Resources 2000-2005" report, shows the rate of deforestation in Nigeria between 1990 to 2005 was about some 6.1 million hectares or 35.7 percent of its forest cover, while reforestation was a mere 32,000 hectares and the country is losing about 350,000 square meters of its land mass to desert condition which is advancing south ward. The aim of this study was to assess the extent of fuel wood exploitation and the observed effects of afforestation/shelter projects by the communities of northern Katsins state.

MATERIALS AND METHODS

Geographical setting of the Study Area

The study area is located between latitude 12^{o} 52'N and13^{o} 19'N and longitude 7^{o} 16'E and 8^{o} 43'E.The landscape is underlain by sedimentary rock, flat with an average of 300 meters above sea level, broken in some parts by hills. Trees and grasses adapt to climate rhythm of long dry season and short wet season. Most trees developed long tap roots, thick bark which enable them to withstand the long dry season and bush fires. The vegetation is subjected to various form of abuse which includes fire, wood cutting, cultivation, overgrazing and bush fire. The area is characterized by unimodal rainfall pattern with most of the rain received between May to September, annual average below 800mm.Temperatures are high in most parts of the year with the mean daily maximum ranging between 27^{o}C to 40^{o}C occurring between March and May. The mean minimum ranging between 18^{o}C to 25^{o}C experienced in the month of November to early February The area has four different seasons; a cool dry season (December to February), a hot dry season (March to May), a warm wet season (May to September) and a season of falling temperature (September to November), (Tomlinson, 2010). The soils are sandy ferruginous type of the latosols group which is highly weathered and markedly laterised and slightly acidic in reaction to low organic matter content and phosphorous, its total nitrogen rarely exceed 0.2%.(Abubakar, 2006) The subsistence rainfed farming is the common economic activity in the area and fragmented farm land form the dominant feature of the land use pattern,

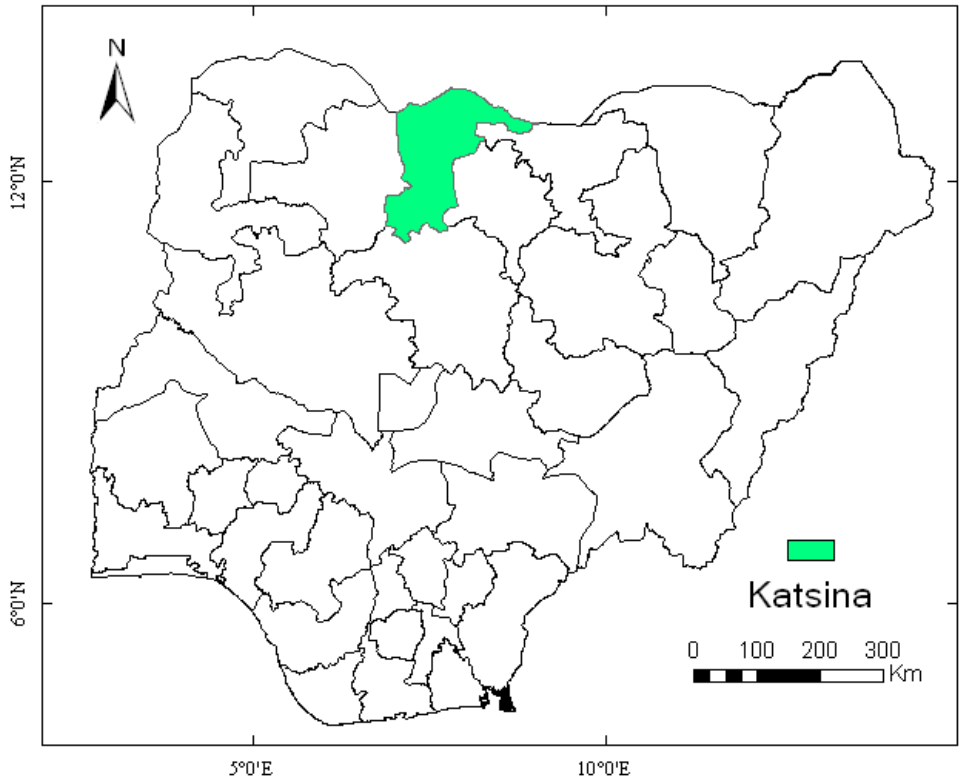

Figure1:Katsina State, Nigeria

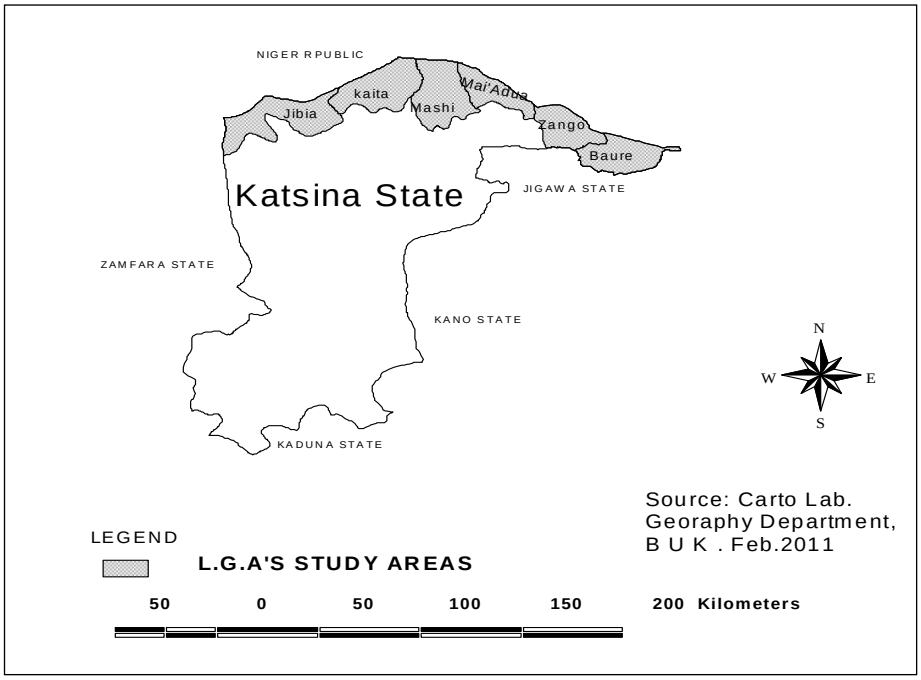

Figure 2: Study Area, in Katsina state

Table 1: **Sample Sizes and Some Characteristics of the Study Area**

Local Govt.	Villages		Location (Coordinate)	Estimated Population	No. of Sample Selected in the village	No. of Sample selected in the Local Govt.	Dominant tribe
Baure	1	Burdudu	$12^0$53'N, $8^0$43'E	1,350	23	46	Hausa/Fulani
	2	Sawani	$12^0$52'N, $8^0$49'E	1,300	23		Hausa/Fulani
Maiadua	1	Bumbum	$13^0$16'N, $8^0$07'E	1,700	17	39	Hausa/Fulani
	2	Kwangwalam	$13^0$10'N, $07^0$32'E	2,200	22		Hausa/Fulani
Mashi	1	Birnin Kuka	$13^0$19'N, $07^0$59'E	3,200	32	57	Hausa/Fulani
	2	Majigiri	$13^0$15'N, $07^0$53'E	2,500	25		Hausa/Fulani
Jibia	1	Magama	$13^0$06'N, $07^0$16'E	3,600	36	53	Hausa
	2	Faru	$13^0$06'N, $07^0$11'E	1,760	17		Hausa
Kaita	1	Dankama	$13^0$18'N, $07^0$47'E	4,500	45	73	Hausa/Fulani
	2	Gishirawa/Matsai	$13^0$10'N, $07^0$40'E	2,800	28		Hausa
Zango	1.	Yakubawa	$13^0$04'N, $08^0$29'E	1,800	18	40	Hausa
	2	Yardaje	$13^0$01'N, $08^0$34'E	2,200	22		Hausa/Fulani
Estimated Population and Samples sizes respectively				28,910	308	308	

Sources: Field Work (2016)

2.2 Household Survey

Twelve villages were purposively selected and these villages are located few meters away from Nigeria – Niger republic border. A pilot survey was conducted to test the reliability of the research tools and techniques. It is important to note that the household were stratified into three (small, medium and large scale farmers), the numbers of samples taken from each category of farmers/herders take into consideration their total percentage in each village. A baseline questionnaire with open-ended and closed-ended questions were used to get information on man-environment relations such as size, land holding, livelihood, farming practices, types and number livestock own, type of plant species used for fuel wood and their sources, availability of fuel wood, distance covered to get fuel wood, and the perceived impact of afforestation efforts

Focus Group Discussion (FGD) of 8-12 people were held in each of the selected village. The FGD is aimed at weighing and balancing the information generated through questionnaire and interview with a

view of getting a consensus. Selections of members of FGD take into consideration, the age, gender, literacy (western or Arabic/Islamic knowledge) and social status of the participants. Descriptive statistics were used in the data analysis.

3.0 RESULTS AND DISCUSSION

3.1 The Demographic Characteristics of the Respondents

The demographic features of the respondents analyzed characteristics such as gender, tribe, age distribution, literacy level and occupation. Table 2 shows an estimated population of each of the selected villages and the number of the samples taken from each village.

Table 2: **The Demographic Characteristics of The Respondents**

	Baure (n=46)		Jibia (n=53)		Kaita (n=73)		Mashi (n=57)		Zango (n=40)		Maiadua (n=39)		Aver-age %
	Fq	%	Fq	%	Fq	%	Fq.	%	Fq.	%	Fe.	%	
GENDER													
Male	41	89	49	92	69	94	51	89	38	95	37	95	92
Female	05	11	04	08	04	06	06	11	02	05	02	05	8
AGE													
10-20	0	0	0	0	03	04	0	0	0	0	02	05	02
21-30	0	0	04	7.0	20	27	07	12	06	15	03	08	12
31 – 40	09	20	07	13	15	20	05	09	04	10	11	28	17
41-50	18	39	13	24	15	20	10	18	15	37	07	18	26
51-60	13	28	12	23	13	18	17	29	08	20	06	15	22
61-70	05	11	11	21	03	4.4	07	13	02	05	05	13	11
71-80	01	02	03	06	02	03	06	10	03	08	02	05	06
Above 80 years	0	0	03	06	02	03	05	9	02	05	03	08	05
LITERACY LEVEL													
Koranic	36	78	32	61	53	72.6	42	73	28	70	32	82	
Primary	4	09	11	21	03	4.1	08	14	05	12	02	05	
Secondary	5	10	07	13.13	15	20.6	05	09	05	12	04	10	
Tertiary	1	03	03	06	02	2.7	02	04	02	06	01	03	
Occupation													
Farming	38	82	43	81	62	85	32	82	46	81	28	70	
Civil Servant	3	07	02	04	03	4.0	02	05	03	05	05	12	81
Trading	1	03	03	06	03	4.0	04	10	02	04	05	12	07
Others	4	08	05	09	05	7.0	07	03	06	10	02	06	07 08

Source: field work (2016)

3.2 The Distribution of the Respondents by Gender and Ethnic Background

The male were the dominant respondents in all the villages, as shown in table 2. In Zango and Mai'adua local government, 95% were male. Only in Mashi local government did female respondents constitute up to 10.6%, and most of them were elderly and widowed. The low percentage of female respondents could be attributed to a religious restriction, which forbids the mixing of males and females in the same place except with a genuine and unavoidable necessity. In all the villages visited, the Hausa were the dominant tribe, but the Fulani were also a sizeable minority. Some of them have already settled, while others do not have permanent residences.

3.3 The Age Distribution of the Respondents

The age distribution of the respondents is an important attribute in determining the productive potential of a society. Table 2 shows those in the age category 41-50 years have the highest percentage of the respondents in Baure (39%) and Zango (37.5%). While those in the age category 51-60 years were the highest in Mashi (29.8%). In Kaita, those in the age category 21-30% years were the dominant respondents (27.3%).

3.4 The Literacy Level

Literacy is the ability of an individual to read and write. It has been found that in most of the study villages of Baure, Kaita, Mashi and Maiadua LGAs, less than 30% of the respondents attended primary and secondary schools and tertiary institutes. For example, in the villages of Bumbum and Kwangwalam (Mai adua LGA) only one respondent (2.7%) attended a tertiary Institution. Jibia local government villages (Faru and Magama) have the highest number of respondents who attended primary schools (20.7%); 13.2% have been to secondary schools, and 5.7% attended tertiary institutions. It is important to note that even most of those who have not been to western style schools, attended traditional/religious school hence a majority can read and write in Arabic. Generally, the younger respondents are more educated than the older.

3.5 The Occupational Distribution of the Respondents

Agriculture is the main occupation of the population, providing the mainstay of the economy. Majority of the respondents (more than 80%) in five local government areas except Mai adua (70%) were farmers. To those who engage both in crop production and livestock rearing, livestock is seen as an inseparable complements to successful farming. An important off-farm activity of the younger men is migration to neighbouring urban centres or to other parts of the country.

3.6. Fuel Wood Exploitation and Management

3.6.1 Types of Cooking Energy

Fuel wood is the most common and widely used source of household energy followed by crop residue (table 3). Household heads, male and female children are responsible for firewood collection. It is usually collected on foot by forming head load or bundles of various sizes. Sometimes donkeys are used in conveying fuel wood from the bush to villages or to nearby towns or local periodic markets .The division of labour in gathering firewood appear to be flexible; other family members gather fuel wood, while herding livestock or when returning on foot from neighbouring villages.

Crop residue is the second most widely used fuel energy used in cooking. After the harvest of crops, the stalks are gathered in one place in a hut shape or put on top of a tree or evacuated from farm to home. Charcoal and kerosene use is very minimal by a very few people, majority are of southern Nigeria origin residing in the villages. Dried animal dung is used by a few pastoralists and few elderly widowed women who could not walk far to gather firewood.

3.6.2 The Sources of Cooking Energy

Most of the respondents gathered firewood or crop residue for cooking purposes from their farms or nearby bushes close to their villages. In Zango, Baure, Jibia and Mai'adua, more than half of the respondents (55%, 54.4%, 53% and 51%) respectively source their cooking energy from their farms. In Maiadua and Mashi, 38.5% of the respondents depend on bushes around their villages to get fuel wood.

3.6. 3 The Availability of Cooking Energy

A large percentage of the respondents admitted that cooking energy was getting scarce or not available around the villages. In Baure, 43.5%, and Jibia 47% of the respondents believed that the source of energy for domestic use was getting scarce. Using woody plants for fuel is the only available and viable option to the rural communities of the study area, as alternative fuel sources are either non-existent or too expensive to patronize. Since there is little or no financial expenditure in the cutting and collection of fuel wood, it is likely to remain the dominant source of cooking energy for rural communities for many years to come.

Table 3: Fuel Wood Exploitation and Management

	LOCAL GOVERNMENT AREAS												Aver-age %
	Baure (n=46)		Jibia (n=53)		Kaita (n=73)		Mashi (n=57)		Zango (n=40)		Maiadua (n=39)		
	Freq.	%	Freq.	%	Freq	%	Frq.	%	Feq.	%	Feq.	%	
Type of Cooking Energy Used													
Firewood	38	83	46	87	61	84	39	68	31	78	27	68	78
Kerosine	04	08	10	19	07	10	03	06	06	14	06	15	12
Animal	02	05	03	06	02	03	03	02	03	0	02	04	4
dung	30	65	36	68	63	72	44	78	34	85	32	83	76
Crop residue	01	02	0	0	02	03	1	02	0	0	0	0	01
Charcoal	0	0	0	00	01	02	02	04	05	13	03	12	06
Others													
Sources of Cooking Energy													
From my farm	25	54.4	28	53	32	44	25	44	22	55	20	51	51
Bushes around our village	18	39	17	32	28	38.1	22	39	14	35	15	38.	37
Purchase	02	4.5	07	13	11	15	08	14	03	7.5	03	08	11
from seller	01	2.1	01	02	02	2.7	02	04	01	2.5	01	03	03
Others													
Availability of Cooking Energy													
Readily available	10	22	13	24	22	30	19	33	12	30	15	40	30
Not Available around our village	12	26	13	24	21	29	13	23	15	37.5	15	40	30
Getting	20	43.5	47	27	21	37	21	37	11	28	09	20	33
scarce	04	8.5	02	04	03	4.3	04	7.0	02	5.0	0	0	05
Others													
Distance covered to get source of energy													
100m –	05	11	12	22	25	35	01	03	04	10	05	13	16
500m	07	16	06	11	03	05	18	32	17	42	19	49	26
600 – 1km	23	48	18	35	33	43	15	22	14	35	08	20	34
1.5 – 2km	07	16	12	22	02	03	23	42	02	05	01	03	15
2.5 – 3km	4	09	05	10	10	10	0	0	03	08	06	15	08
Over 3km													
View on establishing shelter belt/forest reserve													
Will taste our land	07	15.3	10	19	12	16.4	08	15	03	8	03	8.0	14
Will provide protection From wind	18	39.1	21	40	33	45.3	29	50	25	6.3	26	67	51
Will provide firewood one day	11	24	17	32	16	22	16	28	09	23	08	20	25
Will provide pasture for livestock	08	17.3	04	7.0	10	13.6	03	05	03	08	02	05	10
Others	02	4.3	01	02	02	2.7	01	02	0	0	0	0	02

Source: Field Work (2016)

3.6.4 The Distance Covered to Get Fuel wood

The trend in cooking energy availability is reflected in the distance covered to get it. In Baure, 48% of the respondents covered 1.5-3km to collect firewood, while in Mashi, 42% of the sampled population covered up to 2.5-3km to get firewood. As show in table 3, it is only in Maiadua that majority of the respondents covered from 600 metres to 1 kilometre, suggesting that fuel wood is available close to their villages. The reason for the availability close to the villages in Mai'adua has been attributed to the afforestation program, which encourages the individual tree planting in farms. However, one must seek the consent of local authority before felling a tree even within an individual's farm.

Plate 1 : *Azadirachta indica* shelter belt in Bumbum, few meters away from the Nigeria-Niger ` `republic border

3.6.5 Types of Plant Species Used as Fuel Wood

The choice of plant species for fuel wood is influenced my many factors. These include the ability to generate considerable heat with minimum smoke, softness of the wood during cutting and splitting and the ability to dry quickly when cut. Based on these criteria, the farmers gave preference to the following species as fuel wood. *Acacia nilotica, , Acacia Zeyel, Anogeisus schim peri (Hym), Balanites aegytiaca, Batiunia thoningis, Zizipenis spina-christ, Zizipinus mauritania* and *Azadirachta indica.*

3. 7 Local Views and Observed Impact of Afforestation/Shelter in desertification control

Attempt of environmental restoration through large scale afforestation/shelter belt programme in semi-arid areas of northern Nigeria started more than half a century ago. (Mijindadi and Adegbeghin,1991). Most of the respondents' assessments of the impact of afforestation/shelter belt appeared to be in support of this programme. Many respondents have mentioned the impact of the trees planted in reducing destructive power of wind and how it aids deposition of the eroded and transported materials. Others have mentioned how the leaves of the trees break the mechanical force of rain, enabling the water to hit the

ground gently and facilitate quick infiltration of rain and lessen the amount of run off on the ground. Few respondents mentioned benefit of the increased yield derived from farm surrounded by trees.

Despite the claim of increasing afforestation/shelter belt in most part of the study area as widely publicize during the annual tree planting campaigns, such project appeared to be ecologically unsustainable, since the area of degraded land has continue to expand and severity of desertification is increasing throughout the study area. This suggested that, these costly efforts have yielded little success; because it adversely affects natural ecosystem and biodiversity, soil moisture and in some area accelerated desertification.

It has been observed, in some parts of the study area particularly in the afforestation/shelter sites, there is reduction in plants biodiversity due to replacement of natural ecosystem with new exotic species. Because afforestation/shelter belts in most part of the study area are characterized by total land clearance including destruction of natural vegetation. Hence the overall vegetation cover is found to have negatively affected by afforestation with a net decrease in vegetation cover. This observation in the study area is similar to the findings of Coa, et al., (2010) in China. They found where grassland is replaced by trees and shrubs, soil erosion increased significantly at the initial stage or where the trees are not given necessary attention to facilitate their quick growth. They noted that at initial stage dense protective cover of annual plant decreased as trees or shrubs increased in grass land area and the extent of bare soil surface below the tree also increased.

It can be observed in most afforestation sites, the natural biological process that protected the soil from erosion and help in the reduction of evaporation from the soil surface are disrupted by trees-planting. The site can take years to recover, before the recovery, erosion could intensifies and desertification might expand because "succession from bare ground to a stable climatic climax community can take 20-40 years before succession is complete" (Cao, 2008). This problem to some extent may be responsible for the persistent increase in desertification in the study area.

It is also observed in the afforestation site (where *Azadirachta indica* are planted) reduce sunlight under the tree canopies and the release of substance into the environment by the *Azadirachta indica* trees suppress the growth of other species. This has adversely affects the growth of under storey vegetation, hence led to decrease of vegetation cover in the afforestation plots.

It is also noted, some sites selected in northern Katsina state for afforestation/shelter belt are not capable of supporting adequate tree growth. One of the conditions for successful afforestation is to have suitable site capable of supporting proper tree growth. It is observed during the visit of many afforestation/shelter belt sites, not all sites selected meet this basic requirement. Most of the sites used, are marginal land, with shallow laterite soils with hard pan. The slow growing of *Azadirachta indica* in most of afforestation sites could be attributed to unsuitable site and inappropriate choice of species given the study area environmental constraints and low water availability. Trees are believed to have low water use efficiency than other form of vegetation species such as grasses and shrubs (Coa, 2009). Natural vegetation in much of the study area are semi–arid plant communities, well adapted to the environment and have much higher water – use efficiency, than the newly introduced exotic species, and have evolve to use soil water sustainably under these environmental condition.

Conversation with the state forestry officials revealed that the afforestation/shelter belt techniques that proved to be successful over small scale or short-term elsewhere are expanded in large scale without careful assessment to confirm their sustainability. This indicated that too much attention is given to environmental impact rather than their underlying causes. In other word, the most effective solution to land degradation requires mitigation of the sources of the degradation rather than the treatment of the symptoms. The State Ministry of Agriculture should focus in restoration of natural climax rather than afforestation. It also important to emphasize that in reclaiming of degraded land the most appropriate measure to each site should be investigated rather than using the current approach which is based on adopting a single solution (afforestation) for all sites. For instance, land degradation in the study area has been largely attributed to human activities, particularly unsustainable livestock grazing, farming activities, and improper clearance of vegetation. Promoting more sustainable form of these activities should be investigated as a potential alternative, wherever afforestation/shelter belt failed in restoration of the

environment. It is a fact that afforestation/shelter belt may have some beneficial effect in reducing desertification. However, the importance of afforestation/shelter belt is overstated.

Plate 1: *Azadirachta indica* shelter belt in Bumbum, few meters away from the Nigeria-Niger republic border

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4.0 CONCLUSION

The increase in population could necessitate the destruction of more vegetation resources because alternative energy in the form of kerosene and cooking gas was not readily available or affordable. Hence, people have to use the available source of energy (fuel wood) without thinking of the consequences. Also lack of job opportunities and a reliable source of income apart from farming have compelled many farmers to cut down trees in their farms. That is why a heap of fuel wood for sale has become a common feature along the major roads in the study area. As Odihi (2003) rightly observed, poverty and environmental degradation in the form of deforestation are traps that is difficult for poor communities to escape from. He argued that the prevention of the degradation of natural resources is irrelevant to the present need of the poor farmers. For them survival is the most urgent issue. Thus, it is important to stress that "the integrity of the natural environment can only be assured when human integrity is assured through a strategy that ensures a well provisioned society" (Odihi 2003).

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